AYK Region
Norton Sound/Kotzebue
Escapement Report #28

# SQUIRREL RIVER COUNTING TOWER PROJECT
# 1982

By

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## INTRODUCTION

Chum salmon is the predominant salmon species occurring in the Kotzebue Sound drainage. The largest stocks in the drainage originate in the Noatak and Kobuk Rivers. The Kobuk River stock is relatively smaller than the Noatak River stock.

Tagging studies, initiated in 1981, indicated a general tendency for salmon bound for the Squirrel and Salmon Rivers to pass through the commercial fishing district earlier in the season than either the Noatak River or upper Kobuk River stocks.

Current management strategy attempts to afford Kobuk River stocks relatively more protection. Commercial fishing effort is more restrictive during July, when a large proportion of the Kobuk River salmon run is present in the Kotzebue fishing district.

Due to the increase in the quality and efficiency of commercial harvests of intermixed stocks of chum salmon in Kotzebue Sound a need has developed for more precise and timely escapement figures from both the Noatak and Kobuk Rivers.

Estimates of salmon escapements can be obtained by using small aircraft to survey spawning streams. Aerial surveys enable many observations to be made in a relatively short time and at comparatively little expense. However, it is impossible to count every salmon in a stream by aerial surveys since the density and distribution of fish are variable and other factors such as population turnover, sun glare, turbidity, and deep pools further hinder the accuracy of observations. Also, it is not possible to fly over every tributary which may contain substantial numbers of spawners. In view of the above limitations, counts obtained by aerial surveys are considered to be indices of the escapements. Usually the peak count of a stream is regarded as an index. By comparing peak counts or indices from year to year, the relative size of the run can be judged. An estimate of the escapement in a stream is usually obtained by counting in units of 1, 10, 100, or 1,000, depending on the density of spawners, and then summing.

Aerial surveys have been conducted on the Kobuk River drainage since 1962. The lag time between when chum salmon are in the commercial fishery and when they reach the surveyable spawning areas is sufficiently long enough to make this information of little use for in-season adjustments of commercial fishing effort.

A counting tower was positioned on the Squirrel River for the first time in 1982 in an effort to document the timing and magnitude of the salmon run in this stream. The project had other objectives also:

1) To evaluate the operational feasibility of a counting tower at this site.

2) To determine the value of the tower data as in in-season management tool.

3) To evaluate escapement estimates based on aerial surveys by comparison

with tower counts.

4) To periodically sample the subsistence catch in the Kiana area and gather age, sex and length data.

5) To aid in the recovery of tagged chum salmon in conjunction with the 1982 Kotzebue Stock Separation Project.

Description of Area

The Squirrel River is located about 50 miles east of Kotzebue (figure 1) and is the most downstream major tributary of the Kobuk River. The Squirrel River flows in a southerly direction toward it's confluence with the Kobuk River near Kiana. It is one of the clearest streams in the region and has, over the last 20 years, been observed to have the largest number of spawning chum salmon of any Kobuk River tributary.

## METHODS AND MATERIALS

The lowest feasible location on the Squirrel River was chosen to minimize the number of salmon spawning below the tower site and to enhance the value of the tower counts as an in-season indicator of run strength.

The site selected was approximately 44 river miles above the Squirrel River mouth (figure 1) and located on a 60 foot high bluff with an almost vertical bank adjacent to the river. A twenty-four foot scaffolding was placed on top of this bluff. Observers were situated more than 80 feet above the water when upon the tower. An excellent viewing angle of the entire width of the river was provided. The river is approximately 250 feet across at the site and 7 or 8 feet at the deepest points during medium-high water. The current is steady across the entire width of the river with no eddies, even during low water. The observer sat at such height that fish could be counted, even with marginal light and/or water conditions across the entire width of the river (figure 2).

The east facing view eliminated the problem of glare except during the early morning hours (5-9 am) when, it was later learned, few salmon passed anyway.

To further enhance visibility, grommeted, white canvas flash panels were strung across the entire width of the river on quarter inch steel cable. The cable was anchored securely on both banks with deadmen. Sandbags were placed on the panel to hold it as close as possible to the bottom. The flash panel was off the bottom slightly in the deepest part of the river because the current was strong there, causing the canvas to flap like laundry on a clothes line. Due to the disturbing nature of this movement it is unlikely that many fish slipped under the panel at this point.

Two partial weirs, of steel fence posts and fencing, were constructed in the shallows, one on each bank, to ensure that salmon did not swim around the shore end of flash panels during high water conditions. These proved suitable during "normal" water conditions but required rebuilding after floods.

The tower, panel and weirs were installed on July 5, 6, and 7 and counting began on July 8. Each hour, an observer counted salmon, by species, moving upstream and downstream for a 30 minute period. The net upstream count was

multiplied by two to arrive at an estimate of the number of salmon, by species, moving past the tower during that hour. Occasionally, when few salmon were counted (and it was sunbathing weather) hour long counts were conducted.

The initial counting schedule was from 6:00 AM until 12:00 PM. When the daily estimate of chum salmon passing the tower during one of these 18 hour periods increased to more than 100, the operating schedule of the tower was increased to 24 hours per day for the next four days. (July 28 through July 31.

During this period, the increasing number of salmon passing allowed a reasonably accurate determination of the daily temporal pattern of salmon movement. The six hour block of time when the least amount of salmon passed, during these four days was 4:00 AM to 10:00 AM and an 18 hour counting schedule was established which excluded these hours. Thereafter, weather permitting, the tower operated on an 18 hour schedule for 30 days followed by a 24 hour schedule on every fourth day. Twenty-four hour counts occurred on August 4, 8, and 12. Data from these days was combined with previous 24 hour counts to arrive at a better estimate of hourly distribution of chum salmon movement (table 2) so that the 18 hour counts could be expanded to account for salmon passing during hours when the tower was not operating.

Lights were rigged over the flash panel for enhancing visibility during the lengthening dark hours on August 7. Auto headlights were mounted on fence posts and connected to 12 watt auto batteries. This arrangement illuminated the area where greater than 90 percent of the salmon normally passed the tower.

Heavy rain in the Squirrel River drainage, starting on August 12, resulted in high turbid water conditions at the tower site on August 14 and 15 and made counting impossible. Tower operation resumed, on a limited basis, in marginal weather and water conditions until project termination on August 19. It is possible that a few salmon passed the tower site after this date, but rising water and continuing rains would have made counting feasible for at least a few more days.

Attempts to catch tagged salmon as they passed the tower site were made with hook and line and "M-80" guns. Neither proved feasible or convenient and the effort was discontinued.

Logistical support and subsistence catch sampling was originally planned to involve periodic boat trips to Kiana. These trips proved difficult and time consuming early in the season, and impossible later in late July and August when water levels were usually too low for boat travel. Supplies and mail were flown in on charter aircraft to a gravel bar just across the river from camp, which was a suitable strip for a Cessna 185 (figure 1).

## RESULTS

A total of 7,773 chum salmon and 144 pink salmon was counted during hours when 30 minute counts were made. Unexpanded daily counts are presented in table 1. Salmon, both chums and pinks, were first seen on July 13. The five days previous, no salmon were observed and an aerial survey conducted on July 11 failed to produce evidence of any uncounted salmon upriver.

Pink and chum salmon occurred in approximatly equal numbers initially, and then pink counts diminished rapidly. Pink and chum salmon were easily differentiated by tower personnel. No king salmon were seen. Grayling and white fish were observed to reside in the river throughout the project. Some small char appeared in the river coincidental to the arrival of the first salmon and were present during the rest of the observation period.

Tagged salmon were easily seen from the tower, but as a rule, traveled upstream too fast for observers to conveniently capture them. A total of 16 tagged chum salmon were observed moving upstream and 1 tagged chum salmon was observed moving downstream. Information on diurnal movement patterns of salmon was compiled from the 7 days when counts were made during all 24 hours, (table 2). Data from the 24 hour counts on August 4, 8, and 12 were used to expand the data, based on diurnal movements of chum salmon. Based on expanded data, the six hour period when salmon moved least frequently was from 8:00 AM through 2:00 PM instead of the 4:00 AM through 10:00 AM period assumed earlier in the field.

An aerial survey was conducted on August 24 and resulted in an estimated 7,610 chum salmon observed above the tower site. All but 60 of these were live fish, most of which were spawning. Very few salmon were seen in the river below the tower, evidence of little spawning below the tower. It also appeared unlikely that many fish had moved past the tower site, between the five days when the tower project had terminated on August 19 and survey on August 24.

## DISCUSSION AND CONCLUSION

The aerial survey estimate seems remarkably close to the tower count until it is remembered that the tower count is only an estimate of chum salmon passing the tower during hours when counts were made.

Assuming that diurnal movement patterns of chum salmon do not vary significantly from day to day at the tower site, the overall average of hourly contributions to daily counts (table 2) can be used to extrapolate the number of salmon passing during hours when no counts were made. This extrapolation m using "standard" hourly percentages of daily counts is valid only if the tower operated for enough hours of the day in question.

Daily tower counts on days when counts were counted for less than 24 hours but more than 12 hours are extrapolated using the "standard" hourly contribution table to account for fish movement during those hours when salmon were not counted (table 3).

During the days when counts were conducted for 12 hours or less (August 14, 15, 16 and 19) daily total counts are estimated using the average expanded daily count of the most proximate days both before and after when more than 12 hour counts wer made. Since August 19 was the last day of operation, no extrapolation was attempted (table 3).

The daily expanded counts (table 3) resulted in a cumulative escapement estimate of 9,500 chum salmon in the Squirrel River. This estimate is 25% higher than the aerial survey count of 7,610. This aerial survey count is 40% below the previous 9 year average peak aerial survey count (table 4).

The current management plan of the Kotzebue salmon fishery states that if restrictions of commercial fishing effort are necessary in the Kotzebue district to enhance Kobuk (and Squirrel) River escapements, such action should be taken before July 25. During 1982, by this date, only 7% of the observed run had passed the Squirrel River tower. It would appear that the tower data in 1982 would not have been of much value as an early indicator of Kobuk run strength. However, in future years, comparisons of in-season tower data to an increasing data base may be valuable as an indicator of both run timing and strength in the Squirrel River.

The peak of the run past the tower was apparently August 6 or 7, with 55% of the salmon passing during the week of August 3 through 9. Another large increase in counts occurred on August 13 while the water level was rising rapidly due to heavy rains. When water visibility decreased to inches during the next 3 days, tower observation was not possible.

A counting tower project at the chosen site seems feasible. Observation of all salmon passing was possible during good to fair weather and water conditions. Conditions which obscured parts of the flash panel, and thus possibly some fish, occurred during only 65 of those hours or about 9% of the time. However bad conditions, when no fish could be counted caused the cancellation of another 77 scheduled hours of tower operation during the field season. Most of these hours were late in the season when few salmon were running. The use of a different lighting system, during the short period when lights became necessary, might possibly improve the effectiveness of tower observation in marginal conditions.

Changes in suspension of the flash panel across the bottom are needed to ensure that the panel fits more snugly on the bottom.

Although the tower crew did not observe salmon during the first five days of observation, the time was used by the crew to rearrange flash panel and weir materials and to get camp better situated. Due to the possibility of a degree in variance in the timing of the run from year to year, a recommended target date of July 10 is proposed for the start of the tower operation.

A three person tower crew was adequate to run this project at it's present level of activity. Given constraints in budgeting for personnel a two person crew could possibly operate this tower on a slightly reduced counting schedule if extra help was available for project set up and take down.

About once every 10 days to two weeks logistical support flights were necessary. The gravel bar just downstream from the tower is known by local pilots as an excellent landing strip for most small tail dragger type planes. A Cessna 185 can make the round trip from Kotzebue in about an hour. (air time).

It is recommended that heavy equipment such as generators and fuel be taken to the tower site by boat early in July, while water levels are still high and that air charter be used for logistical support thereafter. During camp take down, it is recommended that most equipment be flown out, and that the river boat be left in Kiana pulled up for the winter and the heavy equipment flown out from the strip there.

Table 1. Expanded 1/ daily tower counts, Squirrel River, 1982.

| 1982 Date | Hours Counted | Net Upstream Daily Expanded Counts | | | Cumulative Totals | | |
|---|---|---|---|---|---|---|---|
| | | Chums | Pinks | Kings | Chums | Pinks | Kings |
| 7-8 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7-9 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7-10 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7-11 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7-12 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7-13 | 13 | 25 | 30 | 0 | 25 | 30 | 0 |
| 7-14 | 18 | 3 | 0 | 0 | 28 | 30 | 0 |
| 7-15 | 18 | 25 | 12 | 0 | 53 | 42 | 0 |
| 7-16 | 18 | 46 | 0 | 0 | 99 | 42 | 0 |
| 7-17 | 18 | 8 | 0 | 0 | 107 | 42 | 0 |
| 7-18 | 18 | 48 | 6 | 0 | 155 | 48 | 0 |
| 7-19 | 18 | 62 | 10 | 0 | 217 | 58 | 0 |
| 7-20 | 18 | 88 | 10 | 0 | 305 | 68 | 0 |
| 7-21 | 18 | 24 | 6 | 0 | 329 | 74 | 0 |
| 7-22 | 18 | 10 | 4 | 0 | 339 | 78 | 0 |
| 7-23 | 18 | 40 | 4 | 0 | 379 | 82 | 0 |
| 7-24 | 18 | 80 | 10 | 0 | 459 | 92 | 0 |
| 7-25 | 19 | 96 | 0 | 0 | 555 | 92 | 0 |
| 7-26 | 18 | 88 | 8 | 0 | 643 | 100 | 0 |
| 7-27 | 18 | 154 | 0 | 0 | 797 | 100 | 0 |
| 7-28 | 24 | 222 | 8 | 0 | 1019 | 108 | 0 |
| 7-29 | 24 | 312 | 4 | 0 | 1331 | 112 | 0 |
| 7-30 | 24 | 100 | 4 | 0 | 1431 | 116 | 0 |
| 7-31 | 24 | 162 | 2 | 0 | 1593 | 118 | 0 |
| 8-1 | 18 | 250 | 10 | 0 | 1843 | 128 | 0 |
| 8-2 | 18 | 286 | 6 | 0 | 2129 | 134 | 0 |
| 8-3 | 18 | 602 | 0 | 0 | 2731 | 134 | 0 |
| 8-4 | 24 | 662 | 0 | 0 | 3393 | 134 | 0 |
| 8-5 | 16 | 322 | 0 | 0 | 3715 | 134 | 0 |
| 8-6 | 16 | 698 | 0 | 0 | 4413 | 134 | 0 |
| 8-7 | 18 | 742 | 0 | 0 | 5155 | 134 | 0 |
| 8-8 | 24 | 692 | 4 | 0 | 5847 | 138 | 0 |
| 8-9 | 18 | 528 | 0 | 0 | 6375 | 138 | 0 |
| 8-10 | 18 | 338 | 2 | 0 | 6713 | 140 | 0 |
| 8-11 | 18 | 216 | 4 | 0 | 6929 | 144 | 0 |
| 8-12 | 24 | 192 | 0 | 0 | 7121 | 144 | 0 |
| 8-13 | 18 | 434 | 0 | 0 | 7555 | 144 | 0 |
| 8-14 | 1 | 6 | 0 | 0 | 7561 | 144 | 0 |
| 8-15 | river out | | | | | | |
| 8-16 | 12 | 72 | 0 | 0 | 7633 | 144 | 0 |
| 8-17 | 16 | 64 | 0 | 0 | 7697 | 144 | 0 |
| 8-18 | 16 | 70 | 0 | 0 | 7767 | 144 | 0 |
| 8-19 | 2 | 6 | 0 | 0 | 7773 | 144 | 0 |

1/ 30 minutes counts are expanded for the entire hour. Missing days and hours not included.

Table 2. Average hourly percentage contribution of daily counts, Squirrel River tower on all days 1/ when 24 hour counts were conducted, 1982.

| Time | Sum of hourly counts | Average percentage contribution of hr. to daily count |
|---|---|---|
| 0000-0100 | 124 | 5.31 |
| 0100-0200 | 116 | 4.95 |
| 0200-0300 | 136 | 5.81 |
| 0300-0400 | 54 | 2.31 |
| 0400-0500 | 86 | 3.67 |
| 0500-0600 | 42 | 1.78 |
| 0600-0700 | 38 | 1.62 |
| 0700-0800 | 18 | 0.77 |
| 0800-0900 | 14 | 0.60 |
| 0900-1000 | -2 | -.09 |
| 1000-1100 | 22 | 0.94 |
| 1100-1200 | 14 | 0.60 |
| 1200-1300 | 28 | 1.20 |
| 1300-1400 | 10 | 0.43 |
| 1400-1500 | 74 | 3.16 |
| 1500-1600 | 100 | 4.27 |
| 1600-1700 | 114 | 4.87 |
| 1700-1800 | 128 | 5.46 |
| 1800-1900 | 88 | 3.76 |
| 1900-2000 | 108 | 4.61 |
| 2000-2100 | 202 | 8.62 |
| 2100-2200 | 334 | 14.26 |
| 2200-2300 | 288 | 12.30 |
| 2300-2400 | 206 | 8.79 |
| Total all hours | 2,342 | 100 |

1/ Days when tower was operated 24 hours included July 28, 29, 30, 31 and August 4, 8 and 12.

Table 3. Expansion of Squirrel River escapement estimate to include chum salmon passing during hours when tower was not operated, 1982.

| Date | Hours Counted | Hours Not Counted | Unexpanded Escapement Estimate | Sum of "Standard" % Contribution for Daily Count for All Hrs. Missed(x)1/ | Expansion Factor $\frac{1}{1-x}$ % | Expanded Escapement Estimate | Expanded Cumulative Estimate |
|---|---|---|---|---|---|---|---|
| 7-8 | 18 | 0000-0600 | 0 | 23.83 | 131.29 | 0 | 0 |
| 7-9 | 18 | 0000-0600 | 0 | 23.83 | 131.29 | 0 | 0 |
| 7-10 | 18 | 0000-0600 | 0 | 23.83 | 131.29 | 0 | 0 |
| 7-11 | 18 | 0000-0600 | 0 | 23.83 | 131.29 | 0 | 0 |
| 7-12 | 18 | 0000-0600 | 0 | 23.83 | 131.29 | 0 | 0 |
| 7-13 | 13 | 1200-1500<br>0000-0600 | 25 | 28.62 | 140.10 | 35 | 35 |
| 7-14 | 18 | 0000-0600 | 3 | 23.83 | 131.29 | 4 | 39 |
| 7-15 | 18 | 0000-0600 | 25 | 23.83 | 131.29 | 33 | 72 |
| 7-16 | 18 | 0000-0600 | 46 | 23.83 | 131.29 | 60 | 132 |
| 7-17 | 18 | 0000-0600 | 8 | 23.83 | 131.29 | 11 | 143 |
| 7-18 | 18 | 0000-0600 | 48 | 23.83 | 131.29 | 63 | 206 |
| 7-19 | 18 | 0000-0600 | 62 | 23.83 | 131.29 | 81 | 287 |
| 7-20 | 18 | 0000-0600 | 88 | 23.83 | 131.29 | 116 | 403 |
| 7-21 | 18 | 0000-0600 | 24 | 23.83 | 131.29 | 32 | 435 |
| 7-22 | 18 | 0000-0600 | 10 | 23.83 | 131.29 | 13 | 448 |
| 7-23 | 18 | 0000-0600 | 40 | 23.83 | 131.29 | 52 | 500 |
| 7-24 | 18 | 0000-0600 | 80 | 23.83 | 131.29 | 105 | 605 |
| 7-25 | | 0000-0200<br>0300-0600 | 96 | 18.02 | 121.98 | 111 | 722 |
| 7-26 | 18 | 0000-0600 | 88 | 23.83 | 131.29 | 116 | 838 |
| 7-27 | | 0000-0600 | 154 | 23.83 | 131.29 | 202 | 1,040 |
| 7-28 | 24 | none | 222 | 0 | 100 | 222 | 1,262 |
| 7-29 | 24 | none | 312 | 0 | 100 | 312 | 1,574 |
| 7-30 | 24 | none | 100 | 0 | 100 | 100 | 1,674 |
| 7-31 | 24 | none | 162 | 0 | 100 | 16 | 1,836 |
| 8-1 | 1 | 0000-0600 | 250 | 23.83 | 131.29 | 328 | 2,164 |
| 8-2 | 18 | 0400-1000 | 286 | 8.35 | 109.11 | 312 | 2,476 |
| 8-3 | 18 | 0400-1000 | 602 | 8.35 | 109.11 | 657 | 3,133 |
| 8-4 | 24 | none | 662 | 0 | 100 | 662 | 3,795 |
| 8-5 | 16 | 0200-1000 | 322 | 16.47 | 119.72 | 386 | 4,181 |
| 8-6 | 16 | 0200-1000 | 698 | 16.47 | 119.72 | 83 | 5,017 |
| 8-7 | 1 | 0400-1000 | 742 | 8.35 | 109.11 | 810 | 5,287 |
| 8-8 | 24 | none | 692 | 0 | 100 | 692 | 6,519 |
| 8-9 | 18 | 0400-1000 | 528 | 8.35 | 109.11 | 576 | 7,095 |
| 8-10 | 18 | 0400-1000 | 338 | 8.35 | 109.11 | 369 | 7,464 |
| 8-11 | 18 | 0400-1000 | 216 | 8.35 | 109.11 | 236 | 7,700 |
| 8-12 | 24 | none | 192 | 0 | 100 | 192 | 7,892 |
| 8-13 | 18 | 0400-1000 | 434 | 8.35 | 109.11 | 474 | 8,366 |
| 8-14 | 1 | 0100-2400 | 6 | 94.69 | no expansion | 295 | 8,661 |
| 8-15 | 0 | all | | 100.0 | no expansion | 295 | 8,956 |
| 8-16 | 12 | 0000-1000<br>2200-2400 | 72 | 47.82 | no expansion | 295 | 9,251 |
| 8-17 | 16 | 0000-0600<br>2200-2400 | 64 | 44.92 | 181.55 | 116 | 9,367 |
| 8-18 | 16 | 0000-0600<br>2200-2400 | 70 | 44.92 | 181.55 | 127 | 9,494 |
| 8- | 2 | 0000-0600<br>0800-2400 | 6 | 97.61 | no expansion | 6 | 9,500 |

1/ e expansion factor component, x, for each day, is e % of salmon observed on days when all 24

Table 4. Comparative peak chum salmon aerial survey escapement estimates, Squirrel River, 1973-1982.

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 9 yr. avg. | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mouth to Omar Creek | - | - | 5975 | 1415 | - | - | 0 | - | - | - | 1106 |
| Omar Creek | - | - | - | - | - | - | 0 | 0 | - | - | 111 |
| Omar Cr. to North Fork | 6885 | ? | 2015 | - | - | - | 1500 | - | - | - | 1431 |
| Above North Fork | - | 25638 | ? | 3499 | - | - | 0 | - | - | - | 5042 |
| Squirrel River TOTAL | 12345 | 32523 | 34326 | 6929 | 1964 1/ | 1863 | 1500 1/ | 13536 | 9854 | 12750 | 7690 |

1/ Incomplete survey

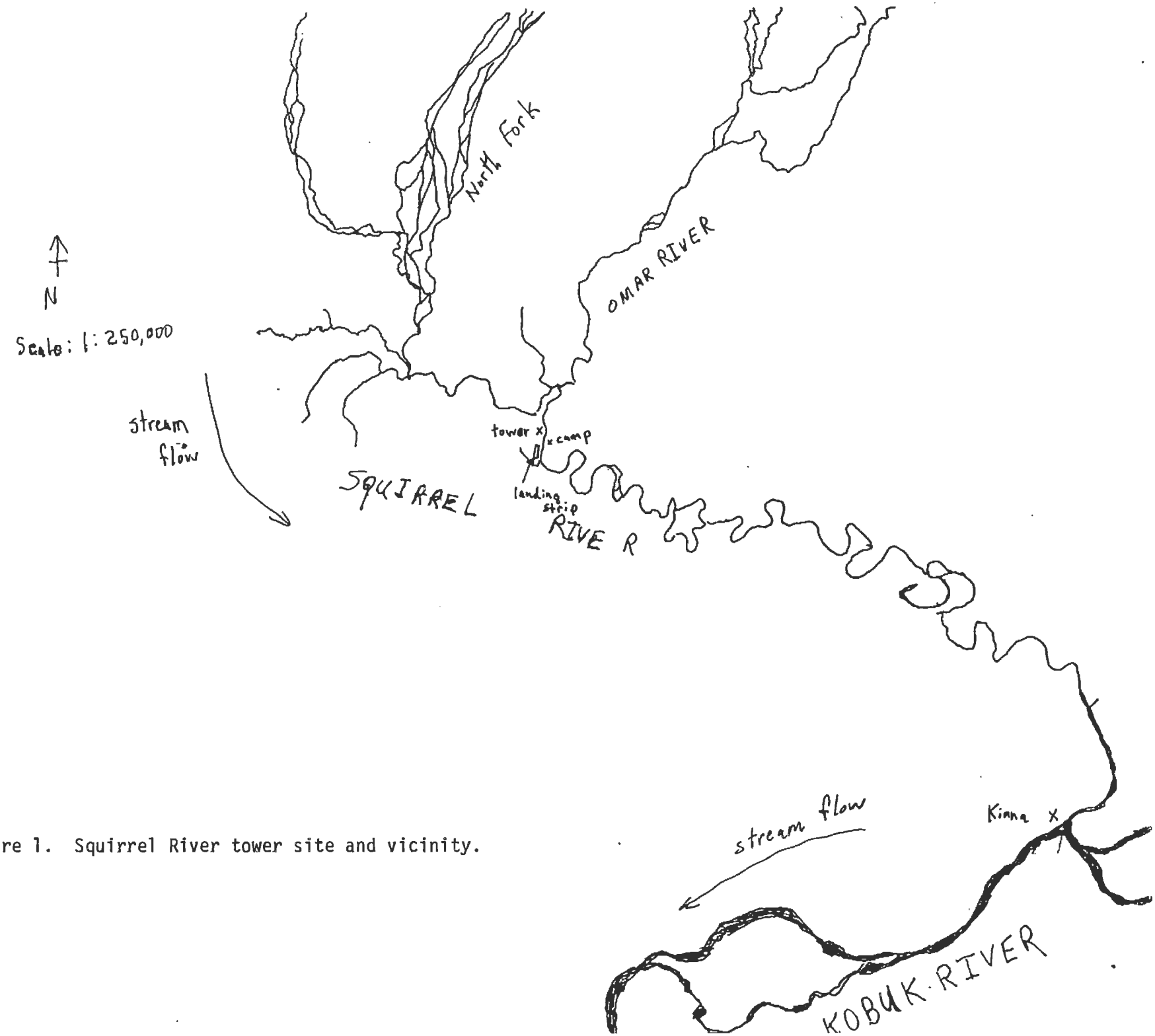


Figure 1. Squirrel River tower site and vicinity.

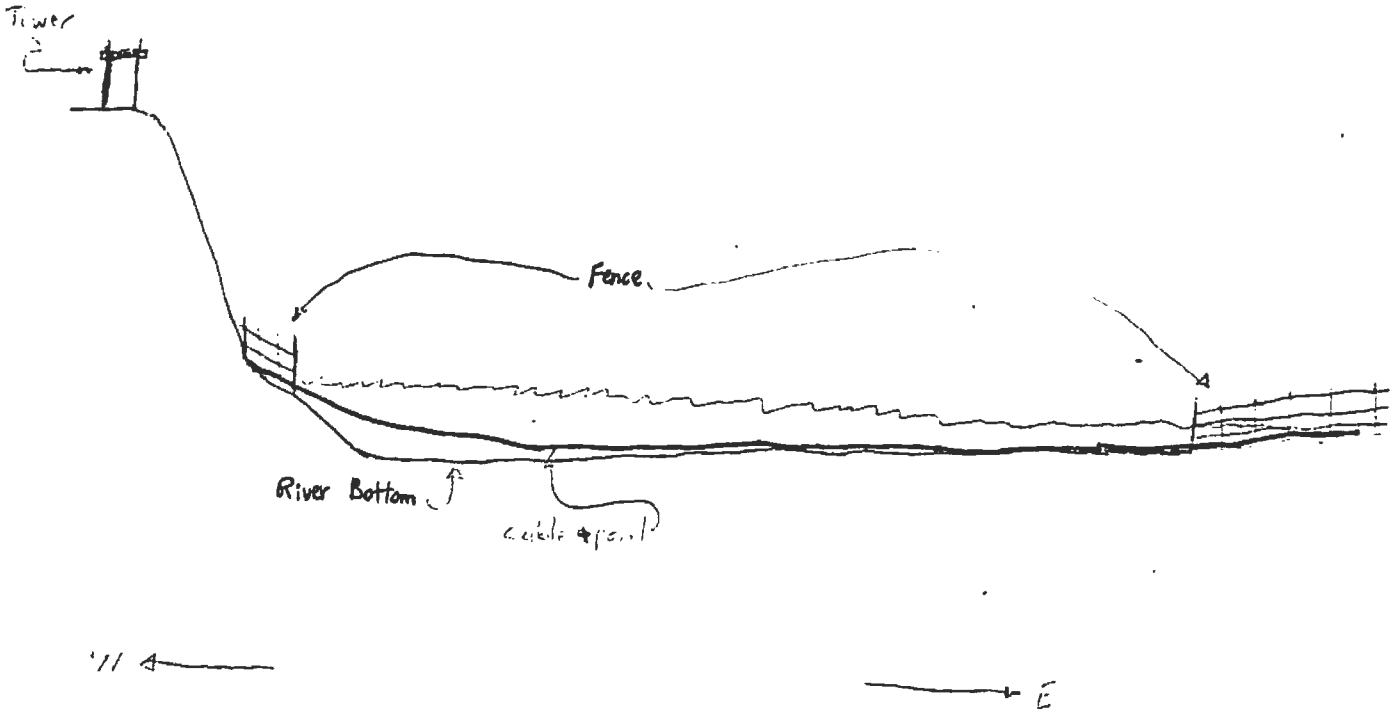


Figure 2. Section of Squirrel River with Tower, Fence and panel